FEED SHAFT CONTROL METHOD AND NUMERICAL CONTROL WORK DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a U.S. National Phase patent application of International Patent Application No. PCT/JP2014/056940, filed Mar. 14, 2014, which is hereby incorporated by reference in the present disclosure in its entirety.

[0002] Field of the Invention

[0003] The present invention relates to a feed axis control method of a machine tool and a numerical control machine tool.

[0004] Background Art

[0005] In conventional techniques, a machine tool which performs machining, such as cutting by relatively moving a tool relative to a workpiece is known. Further, in such a machine tool, a numerical control machine tool which specifies a path of the tool by coordinates of a predetermined axis, and the like, and performs machining by automatically moving the tool relative to the workpiece is known. The numerical control machine tool can perform machining in a desired tool path and at a desired speed by specifying machine coordinates and a movement speed of the tool in a machining program.

[0006] Japanese Laid-open Patent Publication No. 2006-158026 discloses a control device of a machine tool in which a driven element driven by a servo motor is provided with an acceleration detection means. This control device perform correction by obtaining a speed estimation value by integrating an acceleration detection value detected by the acceleration detection means and subtracting a value in which the speed estimation value is multiplied by a coefficient and a value in which the acceleration detection value is multiplied by a coefficient from an electric current command determined by a speed control processing part. Then, the electric current command corrected by the control device is outputted to a servo amplifier.

SUMMARY OF THE INVENTION

[0007] In the control device which controls a servo motor which drives each of axes of the machine tool, a position controller generates a speed command based on a position command, and a speed controller generates a torque command based on the speed command. Then, the motor is driven based on the torque command. Further, it is known that a movement device which moves the tool and the workpiece is provided with the position detector and a position feedback loop which subtracts a position signal outputted from the position detector from the position command is arranged. In addition, it is known that the speed detector is disposed at an output axis of the servo motor, and the like and a speed feedback loop which subtracts a speed signal outputted from the speed detector from the speed command is arranged.

[0008] When the workpiece is machined by the machine tool, a disturbance force is applied to the movement device which moves the workpiece and the tool so that a vibration may be generated on the workpiece or the tool. For example, at a machine point at which the tool is in contact with the workpiece, a cutting load and the like are applied to the workpiece and the tool so that a vibration may be generated. To improve a machining accuracy, such a vibration of the workpiece and the tool is preferably restrained.

[0009] In the control device in Japanese Laid-open Patent Publication No. 2006-158026 as described above, an acceleration of the driven element is fed back to the torque command of the motor, thereby restraining the vibration. However, in such a circuit, the acceleration detection means is disposed at the driven element. In other words, the acceleration detection means is disposed at a position away from the output axis of the motor. Consequently, due to the feedback of the acceleration of the driven element, a position deflection is apt to be generated in the position command outputted from the position controller, and a speed deflection is apt to be generated in the speed command outputted from the speed detector. These deflections influence also upon a control of an electric current supplied to the motor, and there is a problem that an effect of restraining the vibration is reduced.

[0010] A first feed axis control method of the present invention is a feed axis control method of a machine tool, including forming a cascade connection in which a speed feedback loop including a speed control part into which a speed command is inputted is provided inside a position feedback loop including a position control part into which a position command is inputted, and controlling a servo motor for driving a feed axis in accordance with a torque command outputted from the speed control part. The feed axis control method includes obtaining an acceleration based on an output signal of a state sensor attached to at least one of a machine structure and an axis feed mechanism, and subtracting an acceleration feedback signal in which the obtained acceleration is multiplied by a predetermined first gain from the torque command outputted from the speed control part. The feed axis control method includes performing at least one of controls consisting of a control in which a speed is obtained based on the output signal of the state sensor and a signal in which the obtained speed is multiplied by a predetermined gain is added to the speed command outputted from the position control part and a control in which a position is obtained based on the output signal of the state sensor and a signal in which the obtained position is multiplied by a predetermined gain is added to the position command inputted into the position control part.

[0011] In the invention as described above, a speed is obtained based on an output signal of the state sensor, and a signal in which the obtained speed is multiplied by a predetermined second gain can be added to the acceleration feedback signal.

[0012] In the invention as described above, a signal in which the speed command outputted from the position control part is multiplied by a predetermined third gain can be subtracted from a signal multiplied by the second gain.

[0013] In the invention as described above, a position is obtained based on an output signal of the state sensor, and a signal in which the obtained position is multiplied by a predetermined fourth gain can be added to the acceleration feedback signal.

[0014] In the invention as described above, a signal in which the position command inputted into the position control part is multiplied by a predetermined fifth gain can be subtracted from a signal multiplied by the fourth gain.

[0015] In the invention as described above, a signal in which the torque command outputted from the speed control